

**Remarks**

The Office Action dated September 3, 2010, has been received and carefully reviewed. An amendment was filed on November 10, 2010. An Advisory Action was issued on December 14, 2010, refusing to enter the amendment. This paper addresses anew the issues set forth in the final Office Action and addresses the Examiner's response set forth in the Advisory Action.

The preceding amendments and the following remarks form a full and complete response to the final Office Action. Claims 10-16, 20-29, 35, 36 and 49 have been canceled without prejudice or disclaimer. Claims 19, 33, 39 and 40 have been amended. Support for the amendment may be found, for example, in Applicants' specification at page 3, lines 21-35 and page 11, lines 1-31. No new matter has been added. New claims 50-65 have been added. Support for the new claims 50 and 52 may be found, for example, in Applicants' specification at page 4, lines 18-32 and page 6, lines 12-15. Support for the new claim 51 may be found, for example, in Applicants' specification at Figs. 1 and 2 and page 20, line 9-page 21, line 17. Support for the new claims 53-64 may be found, for example, in original claims 3-9 and 30-34, respectively. Support for new claim 65 can be found, for example, in the specification at page 20, lines 16-23. No new matter has been added.

**Declaration Under 37 C.F.R. § 1.132**

Applicants submit herewith a declaration from Dr. Christiane Ripp (the "Ripp Decl.") providing information regarding the cited prior art and the claimed invention and how one of ordinary skill in the art would view the cited prior art and the claimed invention. Dr. Ripp is an inventor of the present application and, as a consultant working for Fortu Research GmbH,

Karlsruhe, and Fortu Intellectual Property AG, Switzerland, has access to and personal knowledge of the experimental work on which international patent applications PCT/DE 00/00177 (PCT Pub. No. WO00/44061) ("Hambitzer '061") and PCT/DE 00/01801 (PCT Pub. No. WO00/79631) ("Hambitzer '631") were based. *See* Ripp Decl. at ¶¶ 1-3. According to the MPEP, the evidence traversing rejections submitted in the timely presented Ripp Decl. "must be considered by the examiner whenever present" and "acknowledged and commented upon by the examiner in the next succeeding action." MPEP § 716.01(B).

#### **Election/Restrictions**

Applicants and Applicants' representatives are deeply disappointed with the Examiner's handling of claim 49, which was withdrawn from consideration as being directed to an invention that is a distinct species from the constructively elected invention recited in the original claims. The Examiner's determination that distinct species are present was based on restriction practice pursuant to 37 CFR §§ 1.141-1.146. *See* Final Office Action at pp. 2-3 (citing 37 C.F.R. § 1.142(b)). According to the MPEP, "unity of invention (not restriction practice pursuant to 37 CFR 1.141 - 1.146) is applicable ... in national stage applications submitted under 35 U.S.C. 371." MPEP § 1893.03(d). The application is a national stage application submitted under 35 U.S.C. 371, and the restriction does not apply the correct "unity of invention" standard.<sup>1</sup>

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<sup>1</sup> Even if restriction practice pursuant to 37 C.F.R. §§ 1.141 - 1.146 were applicable, restriction would still have been improper because claims 1 and 49 are drawn to the same invention. Claim 49 recites the "insulator" using "means for" (i.e., means-plus-function) language while claim 1 explicitly recites the structure of the "insulator." "Where the claims of an application define the same essential characteristics of a *single* disclosed embodiment of an invention, restriction therebetween should never be required." MPEP § 806.03 (explaining that "[t]his is because the claims are not directed to distinct inventions; rather they are different definitions of the same disclosed subject matter, varying in breadth or scope of definition").

In the interview held on October 12, 2010, the Examiner's supervisor agreed that the restriction was improper for this reason and even agreed that the subject matter of claims 1 and 49 were similar. Nonetheless, in the Advisory Action, the Examiner refused to withdraw the restriction and asserted that "[t]he Examiner did not agree to remove the restriction of claim 49." Advisory Action at Continuation Sheet. The Examiner's assertion is technically true because it was only agreed that the restriction was improper, but, typically, it is implicit that an improper restriction will be withdrawn.

In maintaining the restriction requirement, the Examiner **did not even attempt** to explain how the restriction requirement could possibly have been properly based on unity of invention as opposed to restriction practice pursuant to 37 CFR 1.141 - 1.146. Instead, the Examiner merely asserted that the "insulator layer means" of claim 42 "can be a self-supporting film or a particulate structured material such as oxides" and, as a result, "claim 49 is distinct species from the originally filed claims." However, the Examiner did not even attempt to explain why the "porous insulator layer" recited in claim 1 would not also cover an insulator layer that is a self-supporting film or a particulate structured material such as oxides. Thus, the Examiner's attempted explanation is insufficient as it fails to logically support its conclusion that the "insulator layer means" of claim 42 is a distinct species from the "porous insulator layer" recited in claim 1. To be clear, claim 49 cannot possibly be distinct from claim 1 on the basis asserted by the Examiner because the "porous insulator layer" recited in claim 1 would also cover an insulator layer that is a self-supporting film or a particulate structured material such as oxides.

Under the applicable unity of invention standard, the election/restriction requirement was improper because the claims are so linked as to form a single general inventive concept. *See* 37

C.F.R. § 1.475(a). For example, claims 1 and 49 each recites “a negative electrode, an electrolyte containing a conductive salt [and based on  $\text{SO}_2$ ], and a positive electrode.” Further, each of claims 1 and 49 recites an “insulator.” Claim 49 recites the “insulator” using “means for” (i.e., means-plus-function) language while claim 1 explicitly recites the structure of the “insulator.” Accordingly, the requirement of unity of invention is fulfilled because “there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features.” 37 C.F.R. § 1.475(a).

Although Applicants do not agree with the restriction requirement for the reasons set forth above, solely to expedite prosecution, claim 49 has been canceled without prejudice or disclaimer.

**Rejection of Claims under 35 U.S.C. § 112**

Claims 19 and 38-48 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse this rejection for the following reasons.

Claim 19 has been amended to specify that “at least one of the positive and negative electrodes ... has an electrode surface which is essentially free of hydroxide ions.” Support in the as-filed specification may be found, for example, at page 11, lines 1-31. The Examiner has acknowledged that “[t]he present specification supports a cell comprising a negative electrode, an electrode containing salt, and a positive electrode, wherein one of the electrodes has a surface which is essentially free of hydroxide ions.” Final Office Action at p. 4. In addition, in the Advisory Action, the Examiner agreed that this amendment would overcome the rejection under

35 U.S.C. § 112, first paragraph. Advisory Action at Continuation Sheet. Accordingly, Applicants respectfully submit that the claims comply with the written description requirement and respectfully request reconsideration and withdrawal of the rejections.

**Rejection of Claims under 35 U.S.C. § 102**

Claims 1-6, 17-19, 30-34 and 37-48 were rejected under 35 U.S.C. § 102(b) as being anticipated by International Publication No. WO 00/79631 to Hambitzer *et al.* (“Hambitzer ‘631”) with the corresponding U.S. Patent No. 6,730,441 serving as the English equivalent.<sup>2</sup> Applicants respectfully traverse this rejection for the following reasons.

**Independent Claim 1**

Applicants respectfully submit that claim 1 is not anticipated by Hambitzer ‘631 because Hambitzer ‘631 does not disclose each and every feature of claim 1. For example, Hambitzer ‘631 does not disclose “a porous insulator layer ... arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer up to the surface of the positive electrode,” as recited in claim 1. The “arranged and formed” phrase limits the structure of the claimed “porous insulator layer” to only those structures that make it “possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer up to the surface of the positive electrode.”

It is difficult to understand exactly what the rejection of claim 1 is. In the Final Office Action, the Examiner alleges that the separator of Hambitzer ‘631 corresponds to the claimed

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<sup>2</sup> As in the Final Office Action, cites to the text of Hambitzer ‘631 refer to U.S. Patent No. 6,730,441.

“porous insulator.” Final Office Action at p. 4 (“separator (porous insulator structure)”). Then, in the Advisory Action, the Examiner contradicts himself by alleging that “[t]he battery disclosed by Hambitzer [‘631] is the same as that of the invention of claim 1” because “[t]he battery of Hambitzer [‘631] does not require a separator.” Advisory Action at Continuation Sheet. Thus, it appears that the Examiner is uncertain as to what the Examiner is relying for the claimed “porous insulator.” Nonetheless, the rejection of claim 1 is improper because (1) the “porous insulator layer” recited in claim 1 is structurally different than a separator, and (2) all embodiments of Hambitzer ‘631 include a separator.

The “porous insulator layer” recited in claim 1 is structurally different than the battery cell of Hambitzer ‘631 having a porous salt structure and a separator between the negative and positive electrodes because the structure of recited “porous insulator layer” **does not include a separator** that prevents active mass from growing to the positive electrode. Applicants’ specification discloses that “[a]n important feature is that no separator is present between electrodes 3 and 5.” Applicants’ specification at p. 20, lines 17-18. This structural difference between the recited “porous insulator layer” and the porous salt structure and a separator of Hambitzer ‘631 is recited in claim 1, which specifies that the “porous insulator layer ... is arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer to the surface of the positive electrode.” If a separator impermeable to active mass were present, the separator would prevent active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer to the surface of the positive electrode.

As is explained in the portion of the Handbook of Battery Materials (“Handbook”) attached to the Applicants’ Reply filed June 1, 2010, separators “keep the positive electrode physically apart from the negative [electrode] in order to prevent any electric current passing between them.” Handbook at § 9.1.1. Separators have pores which permit an ionic current to pass therethrough but have a small enough diameter “to prevent electronic bridging by deposition of metallic particles floating in the electrolyte.” *Id.* Thus, in sharp contrast to the claimed “porous insulator,” which has pores that **permit** active mass to grow therethrough, a separator has pores that **prevent** active mass from growing therethrough.

The “porous insulator layer” recited in claim 1 is structurally different than a separator due to the size of the pores. According to Applicants’ specification:

The pores of the insulator layer must be sufficiently large to permit the desired growth of the active mass through the layer and up to the surface of the positive electrode. In addition, the structure and the arrangement in relation to the positive electrode must be such that the contact between the active mass and the positive electrode is restricted to local sites (partial areas) of the electrode surface, so that only local short-circuits occur which do not lead to a reaction of further lithium (which is present in the porous insulator layer or at other parts of its boundary to the negative electrode). If a local short-circuit triggers further short-circuits, an uncontrolled reaction of the lithium, i.e. a “thermal runaway”, would have to be expected due to the strong temperature increase.

A suitable structure of the porous insulator layer must be established individually for each particular cell construction. It is to be taken into account that the diameter of the whiskers formed during deposition of the lithium is different from cell to cell. This is shown especially clearly by comparing cells operating with different electrolytes. If an organic electrolyte is used, the whiskers generally have substantially larger diameters than if an electrolyte based on SO<sub>2</sub> is used. Therefore, it is well possible that a layer having a specific porosity prevents the penetration (growing through) of whiskers in a first cell construction, thus acting as a separator, while in another cell, the same layer is penetrated by the deposited active mass.

For this and other reasons, it is practically impossible to provide numerical values or other quantitative information about the pore size of suitable insulator layers. In addition, typical specification data of manufacturers of porous layer materials, such as “average pore size” and “maximum pore size” can in the present case not be used for characterizing suitable layer materials, because the pore size distribution is of substantial significance. For example, a layer which has a high percentage of extremely fine pores, but has a sufficient number of coarser pores through which the active mass may grow, may be suitable. The suitability of a layer material for fulfilling the function described here can, however, be tested experimentally without problems, as will be described in greater detail below.

Applicants’ specification at p. 7, line 15–p. 8, line 14. Thus, a separator has pores small enough to prevent active mass from growing therethrough (while still allowing ionic charge transfer by migration of ions of the conducting salt dissolved in the electrolyte solution), but the recited “porous insulator layer” of claim 1 has pores large enough to permit active mass to grow therethrough.

The Examiner relies on col. 5, lines 25-40 of Hambitzer ‘631 as teaching that “with respect to pore size, the porous layer should be formed and arranged such that the active mass formed on the negative electrode during charging of the cell, **penetrates into the pores of the separator.**” Final Office Action at pp. 5, 12 and 13 (emphasis added). In doing so, the Examiner has mischaracterized the disclosure of Hambitzer ‘631, which actually discloses that “the porous [salt] structure should be formed and arranged in such a manner that the active mass which is formed at the negative electrode during the charge of the cell, **penetrates into the pores of the porous salt structure.**” Hambitzer ‘631 at col. 5, lines 33-37 (emphasis added). The Examiner’s mischaracterization reveals the Examiner’s fundamental misunderstanding of Hambitzer ‘631. The Examiner has apparently failed to appreciate that the separator and the porous salt structure of the additional salt are **different** components. *See Id.* at col. 8, lines 49-51



(“**Salt addition** ... between electrode and **separator**.”). The disclosure in Hambitzer ‘631 that active mass may penetrate into pores of the porous salt structure of the additional salt is **not** a disclosure that active mass may penetrate into pores of the separator. Hambitzer ‘631 does not disclose that active mass penetrates into or through pores of the separator of Hambitzer ‘631. Thus, even though active mass formed at the negative electrode during charge of the cell may penetrate into the pores of the porous salt structure of the additional salt of Hambitzer ‘631, the active mass is not capable of penetrating through the pores of the separator of Hambitzer ‘631.

The separator of Hambitzer ‘631 is located **between** the positive and negative electrodes of Hambitzer ‘631 and **prevents** active mass from growing therethrough. As a result, the separator prevents active mass deposited on the negative electrode from growing up to the surface of the positive electrode. Therefore, even though active mass formed at the negative electrode during charge of the cell may penetrate into the pores of the porous salt structure of the additional salt of Hambitzer ‘631, the active mass is not capable of penetrating through the pores of the separator of Hambitzer ‘631 up to the surface of the positive electrode of Hambitzer ‘631.

Simply put, the presence of the separator in the Hambitzer ‘631, which is located between the positive and negative electrodes and **prevents** active mass from growing therethrough, prevents anything in the Hambitzer ‘631 from being “arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer **up to the surface of the positive electrode**,” as recited in claim 1. (emphasis added). Accordingly, the rejection of claim 1 is improper because Hambitzer ‘631 does not disclose the “porous insulator” recited in claim 1.

Hambitzer '631 also cites international patent application PCT/DE 00/00177, which corresponds to U.S. Patent No. 6,709,789 to Hambitzer et al. ("Hambitzer '789"). Hambitzer '631 at col. 5, lines 41-44. The disclosure of Hambitzer '789 is similar to the disclosure of Hambitzer '631 in that both are directed to the addition of salt to battery cells. Hambitzer '789 is explicit that, "[a]part from the salt 10 arranged in the area of the negative electrode, the [battery cell] design is conventional." Hambitzer '789 at col. 4, lines 10-12. The conventional design contains a separator 5 designed to prevent short-circuit reactions. Hambitzer '789 at col. 3, lines 49-59. Likewise, apart from the salt arranged in the area of the negative electrode of Hambitzer '631, and the quantity of SO<sub>2</sub> relative to its maximum charge capacity, the battery cell design of Hambitzer '631, which includes a separator, is conventional. *See* Hambitzer '631 at col. 5, lines 1-10 and col. 7, lines 1-2. And, it is unreasonable to characterize Hambitzer '631 as disclosing the recited claim features when Hambitzer '631 has a conventional structure with a separator and is designed to prevent growth of active matter from the negative electrode to the positive electrode.

The Examiner asserts that "[t]he porous layer of Hambitzer ['631] is materially and structurally the same as that claimed in claim 1 and therefore is capable of performing the same." Final Office Action at p. 13. However, as explained above, the "porous insulator layer" recited in claim 1 is structurally different than the separator of Hambitzer '631 due to the size of the pores. These structural differences render the structure of Hambitzer '631 incapable of performing in the same manner as the battery cell of the claimed invention.

In the Advisory Action, the Examiner asserts that the difference in the size of pores between the "porous insulator layer" recited in claim 1 and a separator cannot be relied upon to

distinguish the claimed invention from Hambitzer *et al.* because the claims do not recite the pore size of the “porous insulator layer.” Advisory Action at Continuation Sheet. However, this structural difference between the recited “porous insulation layer” and a conventional separator impermeable to active mass is recited in the claims, which specify that the “porous insulator layer ... is arranged and formed such that it is **possible for active mass** deposited on the negative electrode **to grow** during the charging of the cell **through the pores of the insulator layer** to the surface of the positive electrode.” (emphasis added). The Examiner is incorrect because the recited “pores of the insulator layer” must have a size sufficiently large for it to be possible for active mass to grow therethrough, and the basis for the Examiner assertion is not understood. In contrast, a separator impermeable to active mass does not have pores sufficiently sized for active mass to grow therethrough and, thus, does not have a structure that makes it “possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer to the surface of the positive electrode,” as recited in claim 1.

Furthermore, as confirmed by Dr. Ripp, “one or ordinary skill in the art would understand that the pores of a porous insulator layer ... arranged and formed such that it is possible for active mass to grow the pores of the insulator have a size larger than the pores of a separator acting as a barrier layer and impermeable to active mass.” Ripp Decl. at ¶ 21.

For these reasons, separator of Hambitzer ‘631, which is impermeable to active mass, cannot reasonably be relied upon as corresponding to the claimed “porous insulator,” and the rejection of claim 1 is improper. It is possible that the Examiner recognized the many deficiencies in attempting to rely on the separator of Hambitzer ‘631 as corresponding to the

recited “porous insulator” and that recognition prompted the Examiner to make a sudden about-face and assert, in the Advisory Action, that “[t]he battery of Hambitzer [‘631] does not require a separator.” Advisory Action at Continuation Sheet.

The Examiner’s basis for the Examiner’s assertion that Hambitzer ‘631 discloses embodiments of a battery cell having no separator acting as a barrier layer impermeable to active metal is that (1) Hambitzer ‘631 discloses that “[a] separator layer can be applied directly to this foamlike substrate” and (2) the cells of Examples 1 and 2 of Hambitzer ‘631 do not explicitly specify a separator as a component. Advisory Action at Continuation Sheet. However, as confirmed by Dr. Ripp, Hambitzer ‘631 only discloses battery cells having a separator acting as a barrier layer impermeable to active mass. *See* Ripp Decl. at ¶¶ 5-14.

Contrary to the Examiner’s assertion regarding Examples 1 and 2, Hambitzer ‘631 explicitly discloses that the electrochemical cell of Example 1 has a separator formed as part of the negative electrode by applying aluminum oxide to the nickel foam of the negative electrode. Hambitzer ‘631 at col. 7, lines 23-26. Hambitzer ‘631 also discloses that the cell of Example 2 was prepared similar to the cell of Example 1 and no changes to the negative electrode or separator were disclosed. *Id.* at col. 7, lines 47-54. Thus, the Examiner’s assertion regarding Examples 1 and 2 directly conflicts with the explicit disclosure of Hambitzer ‘631.

Hambitzer ‘631 also explicitly discloses a separator as a component of the cell of Examples 4. *Id.* at col. 8, lines 49-51. Example 3 does not explicitly disclose a separator, but, as confirmed by Dr. Ripp, “one of ordinary skill in the art would understand that this is only because a conventional separator is used and not the special type of separator formed as part of the negative electrode as in Examples 1 and 2.” Ripp Decl. at ¶ 11. While, Examples 1 and 2

use a “nickel foam” to which a separator can be applied directly, Example 3 uses a “precision-expanded nickel foil.” *Compare* Hambitzer ‘631 at col. 7, lines 23-26 and 47-54 *with Id.* at col. 8, lines 5-6. According to Dr. Ripp, “[o]ne of ordinary skill in the art would understand that, in Example 3 of Hambitzer ‘631, a conventional separator, which is not applied directly to the negative electrode made of nickel foil, would be used and that no further description mention of the conventional separator would be necessary.” Ripp Decl. at ¶ 11 (citing Hambitzer ‘631 at col. 6, line 62-col. 7, line 2).

Furthermore, as set forth by Dr. Ripp:

[O]ne of ordinary skill in the art would not understand the statement in Hambitzer ‘631 that “[a] separator layer can be applied directly this foamlike substrate” to mean that a separator layer is not required as asserted by the Examiner. In contrast, one of ordinary in the art would understand the statement to mean that either a separator layer applied directly to a metallic foamlike substrate of the negative electrode could be used or a separator layer that is not applied directly to a metallic foamlike substrate of the negative electrode (*i.e.*, a conventional separator layer) could be used. *See* [Hambitzer ‘631] at col. 6, line 62-col. 7, line 2.

Ripp Decl. at ¶ 12.

“Accordingly, based on [Dr. Ripp’s] experience in the field, it is [Dr. Ripp’s] opinion that one of ordinary skill in the art would understand Hambitzer ‘631 to only describe and suggest battery cells having a separator acting as a barrier layer impermeable to active metal.” Ripp Decl. at ¶ 13. Moreover, Dr. Ripp’s opinion is backed up by her “familiarity with the experimental work on which Hambitzer ‘631 was based and the documentation thereof.” *Id.* at ¶¶ 6-8.

For each of the reasons set forth above, Hambitzer ‘631 does not disclose “a porous insulator layer ... arranged and formed such that it is possible for active mass deposited on the

negative electrode to grow during the charging of the cell through the pores of the insulator layer up to the surface of the positive electrode,” as recited in claim 1, and the rejection is improper..

In addition, Hambitzer ‘631 does not disclose “an intermediate space between the positive electrode and the negative electrode is arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface,” as required by claim 1. The “arranged and formed” phrase limits the structure of the claimed “intermediate space” to only those structures that enable “active mass deposited on the negative electrode during the charging of the cell [to] come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface.”

The Examiner alleges that an interface/surface between the positive electrode and the separator of Hambitzer ‘631 corresponds to the claimed “intermediate space.” See Final Office Action at pp. 4, 5 and 12.<sup>3</sup> There is no explicit disclosure of an “interface” or “surface” between the positive electrode and separator layer in Hambitzer ‘631. The Examiner, without any support, alleges that an “interface between the [positive] electrode and the [separator] layer ... is present on all batteries comprising these layers.” See Final Office Action at p. 12. However, it is unclear how an interface/surface between the positive electrode and the separator of Hambitzer ‘631 could possibly correspond to the claimed “intermediate space.”

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<sup>3</sup> The Examiner alleges that “the interface between the electrode and the porous insulator layer” corresponds to the claimed “intermediate space” feature. Final Office Action at p. 12. The Examiner asserted that the separator of Hambitzer ‘631 corresponds to the claimed “porous insulator.” See *Id.* at p. 4. The Examiner also discussed “the surface of the positive electrode and the porous insulator.” *Id.* at p. 5. Thus, it is believed that the Examiner is alleging that the interface/surface between the positive electrode and the separator of Hambitzer ‘631 corresponds to the claimed “intermediate space” feature.

One of ordinary skill in the art would not understand an interface/surface between the positive electrode and the separator of Hambitzer '631 to be "arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface," as recited in claim 1. To begin, interface/surface between the positive electrode and the separator of Hambitzer '631 appears to be nothing more than the surface of the positive electrode itself. If that is the case, it is nonsensical for the Examiner to assert that the surface of the positive electrode is arranged in such way that locally limited short-circuit reactions occur at itself. Also, one of ordinary skill in the art would not understand a two-dimensional interface/surface to be an "intermediate space."

Moreover, one of ordinary skill in the art would not understand an interface/surface between the positive electrode and the separator of Hambitzer '631 to be "arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that locally limited **short-circuit reactions** occur at its surface," as required by claim 1 (emphasis added) because Hambitzer '631 discloses that short circuits are **safety problems**, which are to be **avoided**. Hambitzer '631 at col. 4, lines 42-55.

One means to address the safety problem is the addition of salt having a porous structure. Hambitzer '631 at col. 5, lines 1-40. Hambitzer '631 discloses that "the porous structure should be formed and arranged in such a manner that the active mass which is formed at the negative electrode during the charge of the cell, penetrates into the pores of the porous salt structure." *Id.* at col. 5, lines 33-37. Hambitzer '631 also discloses that it is "generally preferred if at least

during a part of the charge/discharge cycle of the cell there is contact of the salt to the negative electrode, in particular to an active mass formed at the electrode.” *Id.* at col. 5, lines 19-23.

Thus, although Hambitzer ‘631 discloses that active mass deposited on the negative electrode during the charging of the cell may come into contact **with the porous salt structure**, Hambitzer ‘631 does not disclose that “an intermediate space between the positive electrode and the negative electrode is arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact **with the positive electrode**,” as is recited in claim 1. (emphasis added).

In addition, Dr. Ripp confirms that “the battery cells of Hambitzer ‘631 do[] not have a structure that permits active metal deposited on the negative electrode to grow through a porous insulator layer to the surface of the positive electrode only at locally delimited points.” Ripp Decl. at ¶¶ 15-20. As explained by Dr. Ripp:

In contrast [to the claimed invention], the battery cells of Hambitzer ‘631 include a barrier layer impermeable to active metal that prevents active metal deposited on the negative electrode to grow to the surface the positive electrode. Further, if active metal deposited on the negative electrode were to break through the barrier layer of Hambitzer ‘631 to the positive electrode, the breakthrough would not be locally limited, and the contact of the active metal to the positive electrode (*i.e.*, short-circuit) would cause an uncontrolled reaction sequence called “thermal runaway.”

*Id.* at ¶ 16. Additionally, Dr. Ripp points out how Applicant’s specification discloses how the suitability of a material/battery cell structure to both permit active mass to grow therethrough and locally limit short-circuit reactions may be experimentally determined and explains that the separator/battery cell structure of Hambitzer ‘631 is unsuitable for such a purpose. *Id.* at ¶¶ 18 and 19. Accordingly, Dr. Ripp concludes that “the battery



cells of the present application have a structure different than the battery cells disclosed by Hambitzer '631." *Id.* at ¶ 20.

Consequently, Hambitzer '631 does not disclose "an intermediate space between the positive electrode and the negative electrode is arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface," as required by claim 1, and the rejection is improper.

For each of the reasons set forth above, Applicants respectfully submit that claim 1 is patentable over Hambitzer '631 and respectfully request reconsideration and withdrawal of the rejection.

Canceled Claims 2, 17 and 18

Claims 2, 17 and 18 were listed in the statement of the rejection even though the claims had been previously canceled without prejudice or disclaimer. Applicants respectfully request withdrawal of the rejection of the canceled claims.

Dependent Claims 3-6 and 30-34

Claims 3-6 and 30-34 depend on independent claim 1 and are patentable over Hambitzer '631 for the same reasons discussed above with regard to claim 1 as well as for the additional limitations they recite.

Independent Claim 19

Although claim 19 was listed in the statement of the rejection, claim 19 was not specifically addressed in the anticipation rejections. *See* Final Office Action at pp. 3-6. Applicants respectfully submit that claim 19 is not anticipated by Hambitzer '631 because

Hambitzer '631 does not disclose each and every feature of claim 19. For example, Hambitzer '631 does not disclose "an electrode surface [of at least one of the positive and negative electrodes] which is essentially free of hydroxide ions," as required by the claim. The Examiner made no attempt to address this limitation, and the anticipation rejection of claim 19 is improper. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

Dependent Claim 37

Claim 37 depends on independent claim 19 and is patentable over Hambitzer '631 for the same reasons discussed above with regard to claim 19 as well as for the additional limitation recited.

For example, claim 37 additionally recites that an "electrode [that] is essentially free of  $H^+$  ions," as is required by claim 37. Applicants respectfully submit that Hambitzer '631 does not disclose, explicitly or inherently, this feature. The Examiner acknowledges that "Hambitzer ['631] does not specifically disclose wherein the electrode of claim 19 is essentially free of  $H^+$  ions." Final Office Action at p. 6. However, the Examiner alleges that the Hambitzer '631 inherently discloses an electrode having an electrode surface which is essentially free of  $H^+$  ions because "the materials and structure of the battery of [Hambitzer '631] and the present application are the same." *Id.* Applicants' specification states that "'essentially free of  $OH^-$  ions and/or  $H^+$  ions' is to be understood to mean that the passivation of the electrode caused by the presence of the ions, and/or the resulting capacity loss, are reduced to such an extent that the required practical function of the electrode in a battery cell is not impaired thereby." Specification at page 11, lines 21-25. The materials of Hambitzer '631 are not the same as the materials of the present invention because Hambitzer '631 does not disclose that passivation of

the electrode of Hambitzer '631 has been reduced to such an extent that the required practical function of the electrode in a battery cell is not impaired thereby. The reduced passivation is not an inherent feature of electrodes. Rather, in the present invention, the reduced passivation is achieved, for example, through use of the first cleaning component and/or second cleaning component. *See Id.* at page 12, line 6–page 15, line 10.

Furthermore, the experimental results described in the specification in relation to Figs. 5-8 prove that an electrode made of a particular material is not necessarily essentially free of  $H^+$  ions. The  $H^+$  ions referred to in claim 37 generally result from a reaction of water with the electrode material and cause a reduction of the original capacity of the active material. Fig. 7 shows the increased charging voltage of a cell in which passivation has not been reduced (curve B) and shows the essentially constant charging voltage of a cell in which passivation has been reduced (curve A). Similarly, Fig. 8 shows the increased initial capacity and less reduction in capacity by repeated charging of the cell in which passivation has been reduced (curve A) compared to the cell in which passivation has not been reduced (curve B). Therefore, the experimental results described in the specification in relation to Figs. 5-8 prove that an electrode made of a particular material is not necessarily essentially free of  $H^+$  ions.

For these additional, independent reasons, Applicants respectfully submit that claim 37 is patentable over the cited prior art.

Further, it is noted that claim 19 is not addressed in the anticipation rejections but is addressed in the obviousness rejections discussed below. However, claim 37, which is dependent on claim 19, is not rejected in the obviousness rejections. As claim 19 is not anticipated by Hambitzer '631, claim 37 cannot be anticipated by Hambitzer '631, and the

rejection is improper. Applicants respectfully request reconsideration and withdrawal of the rejection and allowance of claim 37.

Dependent Claims 38-48

Claims 38-46 depend on independent claim 19 and are patentable over Hambitzer '631 for the same reasons discussed above with regard to claim 19 as well as for the additional limitation recited. Claims 47 and 48 depend on independent claim 1 and are patentable over Hambitzer '631 for the same reasons discussed above with regard to claim 1 as well as for the additional limitation recited. Further, like claim 19, claims 38-45, 47 and 48 were not addressed in the anticipation rejections. *See* Final Office Action at pp. 3-6.

**Rejection of Claims under 35 U.S.C. § 103**

Dependent Claims 7 and 8

Claims 7 and 8 were rejected under 35 U.S.C. § 103(a) as being unpatentable by reasons of obviousness over Hambitzer '631. Applicants respectfully traverse for the following reasons.

Claims 7 and 8 depend on independent claim 1. As a result, claims 7 and 8 are patentable over Hambitzer '631 for the same reasons discussed in regard to claim 1. Claims 7 and 8 are also patentable over Hambitzer '631 for the additional limitations they recite. For example, claim 7 recites that "the porous insulator layer contains a particle-shaped, fiber-shaped or tube-shaped pore structure material." The Examiner admits that Hambitzer '631 does not disclose this feature. Final Office Action at p. 6. Instead of relying on Hambitzer '631, the Examiner asserts the claimed particular shapes of the pore structure material would have been obvious. Specifically, the Examiner cites *In re Dailey* and asserts that "the courts have held that regarding

changes in shape of the pores of the insulator would be obvious absent persuasive evidence that the particular configuration of the claim was significant.” Final Office Action at pp. 6-7 (citing *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966)).

Contrary to the Examiner’s assertion, *In re Daily* did **not** hold that changes in shape of the pores of an insulator would be obvious absent persuasive evidence that the particular configuration of the claim was significant. *In re Daily* involved a disposable plastic nursing container and had nothing to do with pores of insulators. Instead, according to the MPEP, the court in *In re Daily* “held that the configuration of the claimed disposable plastic nursing container was a matter of choice which a person of ordinary skill in the art would have found obvious absent persuasive evidence that the particular configuration of the claimed container was significant.” MPEP 2144.04(IV)(B).

Here, the particular configuration/shape of the pore structure material of the claimed “porous insulator layer” is significant because the shape of the pore structure affects whether “the electrolyte solution penetrates easily into the [porous insulator] layer.” See Specification at page 8, lines 16-24. Accordingly, the particular claimed shapes of the porous insulator layer would not have been obvious a person of ordinary skill in the art as simply a matter of choice.

Also, because the prior art saw disadvantage in and specifically taught away from permitting active mass deposited on a negative electrode to come into contact with a positive electrode of a battery cell, one of ordinary skill in the art would not have found it obvious to design a battery cell to permit such contact. And further, for the same reason, one of ordinary skill in the art certainly would not have found it obvious to design pores of an insulator layer to permit growth of the active mass therethrough.

In responding to Applicants' arguments, the Examiner asserts that "Hambitzer teaches it would be obvious to change the formation of the pore structure." Final Office Action at p. 13. However, no support is provided for the Examiner's assertion, and nothing in Hambitzer addresses **changing** the formation of pore structure. The Examiner also asserts that "[t]he claimed pore shapes are common pore shapes found within porous structures made of particles or fibers." *Id.* Here again, no support is provided for the Examiner's assertion. The Examiner then asserts that "[t]he present specification does not provide any basis for forming the specific pore shapes that would lead one of ordinary skill in the art to the novelty of the different pore shapes." *Id.* Applicants are unable to make sense of this assertion. There is no requirement that a specification must lead one of ordinary skill in the art to the novelty of an invention. The claim recites that "the porous insulator layer contains a particle-shaped, fiber-shaped or tube-shaped pore structure material." The significance of the recited shapes, as disclosed by Applicants' specification, is discussed above, and none of the cited prior art teaches or suggests the recited shapes. Therefore, the rejections are improper regardless of whether Applicants' specification would lead one of ordinary skill in the art to the novelty of the different pore shapes.

Accordingly, the rejection of claims 7 and 8 is improper for this additional, independent reason, and reconsideration and withdrawal are respectfully requested.

#### Dependent Claim 9

Claim 9 was rejected under 35 U.S.C. § 103(a) as being unpatentable by reasons of obviousness over Hambitzer '631 in view of U.S. Patent No. 4,283,469 to Goebel et al. ("Goebel"). Applicant respectfully traverses this rejection because Goebel does not overcome the deficiencies of Hambitzer '631 explained above in regard to claim 1. Therefore, claim 9 is

patentable over Hambitzer '631 in view of Goebel for the same reasons discussed in regard to claim 1 as well as for the additional limitations claim 9 recites.

Claims 19 and 38-48

Claims 19 and 38-48 were rejected under 35 U.S.C. § 103(a) as being unpatentable by reasons of obviousness over International Publication No. WO 00/44061 to Hambitzer *et al.* ("Hambitzer '061") with the corresponding U.S. Patent No. 6,709,789 serving as the English equivalent,<sup>4</sup> in view of U.S. Patent No. 6,596,440 to Gavelin *et al.* ("Gavelin"). Applicants respectfully traverse the rejections and submits that the claims are patentable over the cited references.

The rejection of claim 19 is improper because Hambitzer '061 and Gavelin, alone or in combination, fail to teach or suggest each and every feature of amended claim 19. For example, neither Hambitzer '061 nor Gavelin teaches or suggests that "at least one of ... positive and negative electrodes has an electrode surface which is essentially free of hydroxide ions," as recited in claim 19.

The Examiner acknowledges that "Hambitzer ['061] does not specifically disclose wherein an electrode has an electrode surface which is essentially free of hydroxide ions." Final Office Action at pp. 7-8. Instead, the Examiner relies on Gavelin as teaching, in col. 5, lines 39-56, that "it is important to reduce growth of the passivation films which in turn results in improved battery performance when the electrolyte is applied to the battery." Final Office Action at p. 8. The Examiner then asserts that:

At the time of the invention, it would have been obvious to one of ordinary skill in the art to **modify** the battery of Hambitzer ['631] by **reducing**

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<sup>4</sup> As in the Final Office Action, cites to the text of Hambitzer '061 refer to U.S. Patent No. 6,709,789.

**the growth of the passivation films at the electrode surfaces**, because Gavelin ... recognizes that such films decrease performance of lithium secondary batteries. Furthermore, it is the position of the Examiner that properties such as the electrode surfaces being free from hydroxide ions are **inherent, given that the materials and structure** of the battery of Hambitzer ['631] and Gavelin ... and the present invention **are the same**.

Final Office Action at p. 8 (emphasis added).

The rejection of claim 19 is improper because **(1)** a teaching of the desirability to reduce passivation **in general is not** a teaching or suggestion of “an electrode surface which is essentially free of hydroxide ions,” as recited in claim 19, and **(2)** the **materials and structure** of Hambitzer '631 and Gavelin are **not the same** as the structure of the cell of claim 19.

1. General Teaching is Not a Specific Teaching

In regard to the Examiner's reliance on the general teaching of Gavelin, the invention of Gavelin “concerns a polymer electrolyte.” Gavelin at col. 5, lines 17-24. Gavelin discloses that:

In addition to an improved conductivity when using the **polymer electrolyte** concept of the present invention, an improved compatibility towards die electrode surfaces can be addressed by the amphiphilic graft copolymer in, the electrolyte. It is commonly believed that anionic species can form **oligomers** on the electrode surfaces and these organic species are not evenly distributed on the electrode surfaces, but are thought to form domains of varying thickness. These domains are commonly regarded as parts of the second passivation layer formed during cycling of the lithium polymer battery. **Reducing the growth of these oligomers means reducing passivation films and this will result in improved battery performance when the electrolyte is applied in a lithium polymer battery.** The amphiphilic nature of the copolymer, having strong hydrophobic and hydrophilic grafts, results in a self-organizing effect of the grafts in the electrolyte reducing the passivation phenomena at the electrode surfaces.

*Id.* at col. 5, lines 39-56 (emphasis added). Thus, Gavelin refers to the problem of electrode passivation, but with completely different materials, namely with a polymer electrolyte. In this



context, electrode passivation is reduced by using an amphiphilic graft copolymer having a specific structure as claimed in claims 1 and 8 of Gavelin.

The only similarity is reference to the passivation phenomena at the electrode surfaces. Of course electrode passivation is a general problem in the battery art and any skilled person would aim to reduce same. However, claim 19 does not merely recite an electrode surface of an electrode at which passivation has been reduced. To the contrary, claim 19 recites an electrode surface of an electrode at which passivation has been reduced in a specific way. In particular, claim 19 specifies that the “electrode surface ... is **essentially free of hydroxide ions.**” (emphasis added). None of the cited prior art, including Gavelin, teaches or suggests “an electrode surface which is essentially free of hydroxide ions.”

To be clear, Gavelin’s teaching of the desirability to reduce passivation **in general is not** a teaching or suggestion of “an electrode surface which is essentially free of hydroxide ions,” as recited in claim 19. Likewise, the specific manner of reducing passivation taught by Gavelin (*i.e.*, electrode surface having reduced growth of oligomers) is very different than and in no way a teaching or suggestion of “an electrode surface which is essentially free of hydroxide ions,” as recited in claim 19.

Furthermore, even if the growth of oligomers on the surface of the electrode of Hambitzer ‘061 were reduced, as is apparently proposed by Examiner, it is unclear why the Examiner believes that the reduction in oligomer growth would result in the electrode of Hambitzer ‘061 being inherently “essentially free of hydroxide ions,” as recited in claim 19. Certainly, an electrode surface having a reduced growth of oligomers is not inherently (*i.e.*, necessarily) “essentially free of hydroxide ions.”

Applicants' specification refers specifically to cells operating with a special type of inorganic battery cells, namely cells operating with a SO<sub>2</sub>-based electrolyte. Applicants' specification at page 10, line 20-page 11, line 31. In this specific context, the invention is based on the surprising finding of the inventors that the passivation of electrodes may be attributed to a reaction of the surface molecules of the electrode with water (*e.g.*, from ambient humidity) resulting in the formation of a cover layer which contains a hydroxide of the active metal.

The invention could not have been made without this finding and nothing in Gavelin provides the slightest hint in this direction. Rather, Gavelin discloses that, in cells using the "polymer electrolyte concept," the passivation is attributed to the formation of oligomers which are an organic species forming domains. Gavelin at col. 5, lines 39-56. The invention of Gavelin is based on the reduction of the growth of these oligomers. One of ordinary skill in the art would have readily understood that the reduction of organic oligomers has no applicability to an inorganic "electrolyte ... based on SO<sub>2</sub>" recited in claim 19.

The inapplicability of the teachings of Gavelin to a battery cell having an "electrolyte ... based on SO<sub>2</sub>," as recited in claim 19, is confirmed by Dr. Ripp, who explains why "a person skilled in the art would not have considered Gavelin when trying to solve any problems in a SO<sub>2</sub>-cell," and that, "even if she or he referred to Gavelin, nothing useful could be found therein regarding problems of passivation in a SO<sub>2</sub>-cell." *See* Ripp Decl. at ¶¶ 22-25 and 36-39.

## 2. The Materials and Structure are Not the Same

In regard to the materials and structure, the materials and structure of the combination of Hambitzer '061 and Gavelin and the product of claim 19 are not the same and, therefore, no inherent disclosure can be present. To begin, an electrode surface is not inherently essentially

free of hydroxide ions. For example, Applicants' specification discloses removing "OH<sup>-</sup> ions ... from the electrodes using a cleaning agent which contains a first cleaning component reacting with OH<sup>-</sup> ions." Applicants' specification at p. 10, lines 12-18. Furthermore, the experimental results described in the specification in relation to Figs. 5-8 establish the difference between an electrode having reduced passivation and an electrode in which passivation has not been reduced. The hydroxide ions referred to in claim 19 cause "passivation" of the electrode, resulting in an increase of the internal resistance of the cell and an unfavorable reduction in capacity over a plurality of charging and discharging cycles. Fig. 7 shows the increased charging voltage of a cell in which passivation has not been reduced (curve B) and shows the essentially constant charging voltage of a cell in which passivation has been reduced (curve A). Similarly, Fig. 8 shows the increased initial capacity and less reduction in capacity by repeated charging of the cell in which passivation has been reduced (curve A) compared to the cell in which passivation has not been reduced (curve B). Therefore, the experimental results described in the specification in relation to Figs. 5-8 prove that an electrode made of a particular material is not necessarily essentially free of hydroxide ions. Also, an electrode having a surface that is **not** "essentially free of hydroxide ions" is **not the same** as an electrode having a surface that is "essentially free of hydroxide ions."

In the Advisory Action, the Examiner asserts that "Applicant's disclosure does not provide adequate 'unexpected results'" because "[t]he results displayed in Figs. 5-8 are only from a limited number of samples which are not enough to show consistency in the results," which are also "not commensurate with the scope of the prior arts." Advisory Action at Continuation Sheet. To begin, the Examiner appears to have misunderstood our arguments set

forth above and on pages 34-35 of the After-Final Reply filed November 10, 2010. Figs. 5-8 are/were discussed to illustrate the differences between the claimed invention and the proposed combination and no assertions regarding “unexpected results” have been made. Thus, Figs. 5-8 are/were discussed to show that the Examiner erred in his finding of obviousness instead of to provide rebuttal evidence to show that the claimed subject matter would have been nonobvious.

The Examiner also seems to have several misunderstandings about “unexpected results.” Unexpected results are but one form of rebuttal evidence (or secondary considerations) to show that the claimed subject matter would have been nonobvious. Other forms of rebuttal evidence include commercial success, long felt but unsolved needs, and failure of others. MPEP § 2145. Furthermore, there is no requirement that “unexpected results” be commensurate in scope of the prior art, as alleged by the Examiner. Instead, the unexpected results, like other objective evidence of nonobviousness, “must be commensurate in scope with the **claims** which the evidence is offered to support.” MPEP § 716.02(d) (emphasis added). Plus, the Examiner’s assertions about Figs. 5-8 not showing consistency in results seem to have no basis in fact or U.S. patent law.

Nonetheless, now that the Examiner has brought it up, according to Dr. Ripp, “it is unquestionable that one of ordinary skill in the art would understand the results of the experiments disclosed in the patent specification (with reference to Figs. 5 to 8) to confirm the superior results achieved with electrodes that are essentially free of hydroxide,” and “one of ordinary skill in the art, at least at the time of the invention, would have understood the superior results to be unexpected.” See Ripp Decl. at ¶¶ 32-35. Therefore, the results shown in Figs. 5-8 are both commensurate in scope with claim 19 and “unexpected” and rebut the Examiner’s

finding of obviousness. Accordingly, the rejection of claim 19 is improper for this additional reason.

The Examiner acknowledges that “Hambitzer [‘061] does not specifically disclose wherein an electrode has an electrode surface which is essentially free of hydroxide ions.” Final Office Action at pp. 7-8. Instead of attempting to rely on inference, the Examiner proposes a combination in which the electrode surface of Hambitzer ‘061 is “modif[ied]” in accordance with the teachings of Gavelin. Final Office Action at p. 8. However, Gavelin discloses reducing the growth of oligomers on the surface of an electrode. Gavelin does not teach or suggest “an electrode surface which is essentially free of hydroxide ions.” Even if the growth of oligomers on the surface of the electrode of Hambitzer ‘061 were reduced, the electrode of Hambitzer ‘061 would not be “essentially free of hydroxide ions,” as recited in claim 19.

In addition, Gavelin clearly teaches an organic polymer electrolyte **completely different** from the inorganic SO<sub>2</sub>-based electrolyte recited in claim 19. Gavelin refers to polymer electrolytes and to a battery cell containing such an electrolyte. In particular he refers to lithium ion secondary batteries. Gavelin at col. 1, lines 66-67. Gavelin explains that, in these cells, organic liquid electrolytes are used and that these electrolytes provide high conductivity (thereby high battery cell currents), but are also the cause of problems, (*e.g.*, leakage of the electrolyte out of the battery, vaporization of the solvent of the electrolyte, and dissolution of the electrode material in the electrolytic solution). *Id.* at col. 2, lines 7-13. Gavelin then goes on to explain that, in order to address the problem of leakage, solid polymer electrolytes have been proposed, but that conventional solid polymer electrolytes have insufficient ionic conductivities which are between 1 and 3 orders of magnitude lower than an acceptable value of 10<sup>-3</sup> S/cm. *Id.* at col. 2,

lines 21-32. Gavelin furthermore explains that, compared to polymer electrolytes, better electrical conductivity is achieved by polymer gel electrolytes formed by tapping an electrolyte (*i.e.*, an organic solvent mixture containing dissolved lithium salt, in a polymer matrix). *Id.* at col. 2, lines 47-49. With respect to this type of electrolyte Gavelin notes mainly two drawbacks:

(a) It is a two-phase material which does not offer sufficient long-term stability due to phase separation. *See Id.* at col. 2, line 63-col. 3, line 1.

(b) The reliability of the battery cells is reduced because conventional polymer gel electrolytes have poor chemical compatibility with the electrodes. The reason for this poor compatibility is “the build-up of passivation films, mainly at the interfaces between the negative electrode and the polymer gel electrolyte, because of the high content of organics solvent.” The passivation film has two layers, namely an inorganic first layer and an organic second layer. A special problem with the second layer is, according to Gavelin, that it “increases in thickness with cycling of the battery cell, and this increase is regarded as the main problem when using polymer gel electrolytes ... .” *See Id.* at col. 3, lines 1-15.

On this basis, Gavelin proposes a new type of polymer electrolyte comprising a polymer, a metal salt (*i.e.*, conducting salt), and optionally at least one plasticizer or solvent. Gavelin’s polymer has a specific structure, namely an amphiphilic graft copolymer comprising a backbone on which both hydrophilic and hydrophobic grafts are attached to different carbon atoms. Examples of suitable conducting salts are listed in col. 9, lines 38-57.

Effects achieved by Gavelin's invention are described in columns 5-7. As noted above, Gavelin refers to the above explained problem regarding the compatibility of the polymer with the electrode surface, noting that:

anionic species can form oligomers on the electrode surface and these organic species are not evenly distributed on the electrode surface but are thought to form domains of varying thickness. These domains are commonly regarded as parts of the second passivation layer formed during cycling of the lithium polymer battery. Reducing the growth of these oligomers means reducing passivation films and this will result in improved battery performance when the electrolyte is applied in a lithium polymer battery. The amphiphilic nature of the copolymer, having strong hydrophobic and hydrophilic grafts, results in a self-organizing effect of the grafts in the electrolyte reducing the passivation phenomena at the electrode surfaces.

*Id.* at col. 5, lines 43-56. In regard to this effect, Gavelin further explains that “[t]he amphiphilic graft copolymers will interact advantageously with the solvent or plasticizer of the electrode surfaces, which results in a decrease of the growth of the passivation film with an improved capacity of the whole battery system as a result.” *Id.* at col. 7, lines 30-34.

On this basis it becomes very clear that Gavelin differs from the present invention in a plurality of ways:

(a) Gavelin refers to organic electrolytes as used in conventional lithium ion batteries. In contrast, claim 19 recites an inorganic SO<sub>2</sub>-based electrolyte solution. According to Applicants' specification, “[a]n electrolyte is designated as ‘SO<sub>2</sub>-based’ if it contains SO<sub>2</sub> not only as an additive in low concentrations, but rather the mobility of the ions of the conductive salt which is contained in the electrolyte and causes the charge transport, is at least partially ensured by the SO<sub>2</sub>.” Applicants' specification at p. 4, line 35-p. 5, line 3.

(b) Gavelin addresses a type of passivation which is specific to organic electrolytes, namely generation of a passivation layer of organic nature which increases in thickness with cycling of the battery cell. This has nothing to do with a passivation effect caused by  $\text{OH}^-$  ions or by  $\text{H}^+$  ions in an inorganic cell.

(c) The effect of reduced passivation is, in the case of Gavelin, explained by a reduction of the growth of oligomers, which Gavelin discloses as the cause of the passivation. This has nothing to do with the basic finding of the invention according to which in the specific context of a  $\text{SO}_2$ -based battery cell, passivation is caused by the presence of  $\text{OH}^-$  ions and  $\text{H}^+$  ions.

As the teachings of Gavelin are only applicable to polymer electrolyte, the electrolyte of the combination of Hambitzer '061 and Gavelin must also be a polymer electrolyte and not the "electrolyte ... based on  $\text{SO}_2$ ," as recited in claim 19. Accordingly, the Examiner's allegation of inherent disclosure is improper because the essential materials and functions are substantially different. As noted above, the inventors recognized for the first time that, in this specific case of a  $\text{SO}_2$ -based electrolyte, the electrode passivation may be attributed to a reaction of the surface molecules of the electrode with water (e.g. from ambient humidity), resulting in the formation of a cover layer which contains a hydroxide of the active metal. The invention could not have been made without this finding and Gavelin provides no information which would even be remotely similar.

Gavelin lists of several salts including sulfinate groups that can be used for the preparation of the polymer electrolyte. Gavelin at col. 9, lines 38-57. Although not cited in the Office Action, the Examiner mentioned these salts and the sulfinate groups in attempting to



explain his position on why the teaching of Gavelin would be applicable to a  $\text{SO}_2$ -based electrolyte. The salts to which Gavelin refers can be used as components of the polymer electrolyte solution, namely as **conducting salt**. Some of the chemical formulae listed in the document include " $\text{SO}_2$ ." However, these are **sulfinate groups** as part of one of the ions of the described salts. Nothing is mentioned about **sulfur dioxide**, which is the compound on which the claimed electrolyte is based. Also, nothing is mentioned about using sulfur dioxide as a compound for any function of a battery cell. Therefore, the polymer electrolyte solution is not an "electrolyte ... based on  $\text{SO}_2$ ," as recited in claim 19, and the teaching of Gavelin would not be relevant to the invention of claim 19. It is very basic knowledge of chemistry that functions of a certain compound, such as sulfur dioxide (*i.e.*,  $\text{SO}_2$ ), and a group containing the same atoms in a larger molecule, such as a sulfinate group, have **nothing** to do with each other.

This is further illustrated by comparing a gaseous molecule to a substance comprising the atoms of the gaseous molecule. There are gaseous substances which consist only of a few atoms. For example, carbon dioxide  $\text{CO}_2$ , carbon monoxide  $\text{CO}$ , hydrogen sulfide  $\text{H}_2\text{S}$  and sulfur dioxide  $\text{SO}_2$  are each gaseous substances consisting of only a few atoms. Because of the low molar mass and the stable inner bondings, these molecules are gaseous.

In some cases these simple molecules can build weak interactions with other substances and their physical condition changes from gaseous to liquid. Because there is no chemical bonding between the molecule and the other substance, the physical and chemical properties of the molecule don't change. If you separate the molecule and the substance from each other, you get the initial materials.

An example for this is the electrolyte described in Applicants' invention. Gaseous sulfur dioxide interacts with solid salt Lithiumtetrachloroaluminate and a liquid results. There are no chemical bondings between the salt and the sulfur dioxide. If you heat the liquid, the interaction between the two substances become weaker and you get a separation in the gas and the salt again.

In the organic chemistry field, there are many possibilities to create molecules with specific properties. For carbon chains, there are different functional groups at the C atoms. For example, acetic acid is formed when ethanol is oxidized (*i.e.*,  $\text{CH}_3\text{COH} + \text{O} = \text{CH}_3\text{CO}_2\text{H}$ ). Because of the different groups at the second C atom, the first substance has the properties of an alcohol and the second the properties of an acid. The alcohol comprises the bonded atoms C-O. It is the same composition like in carbon monoxide CO. However, the alcohol has no chemical properties similar to the properties of carbon monoxide, because the chemical environment is different. Further, the same applies to the acid. There is the combination of one C atom and two O atoms to a  $\text{CO}_2$ -group, but you can't find the properties of carbon dioxide within the acid molecule.

The Gavelin patent describes conducting salts with different functional groups. There are salts which comprise a Sulfinate group  $\text{SO}_2$ . Here again, the existence of the one S atom bonded to two O atoms does not imply that the Sulfinate group in the conducting salt shares any of the same properties as a sulfur dioxide molecule. Accordingly, one of ordinary skill in the art would not expect the teaching of Gavelin to be relevant to the battery cell of claim 19 having an "electrolyte ... based on  $\text{SO}_2$ ."

Moreover, Gavelin's disclosure concerning the potential usefulness of a species as a **conducting salt cannot be transferred** to a potential usefulness as a **solvent** of an electrolyte solution. As is explained in the attached portion of the Handbook of Battery Materials ("Handbook"), an electrolyte for batteries is an ion conducting solution which consists of a solvent S and a salt, in the case of a lithium battery a lithium salt. Handbook at p. 457, left column. The two constituents are discussed in the following sections 7.2.1 and 7.2.2 of the Handbook. On page 459, left column, a plurality of classes of potential solvents is listed. Page 460 provides a table of solvents used for lithium batteries including several organic compounds (as used by Gavelin) and also sulfur dioxide. The requirements regarding salts are listed in the first paragraph of section 7.2.2 on page 461 and examples are given later in this section. Not a single important property or requirement regarding a solvent is the same as with a conducting salt. Both are simply distinct elements of an electrolyte solution fulfilling different requirements. As such, one of ordinary skill in the art would not expect the teaching of Gavelin to be relevant to the battery cell of claim 19 having an "electrolyte ... based on SO<sub>2</sub>," and the rejection is improper. See Ripp Decl. at ¶¶ 22-25 and 36-39.

The Advisory Action concludes with an assertion that, because "Hambitzer ['631] discloses that the positive electrode does not have to be LiCoO<sub>2</sub> and that it can be carbon or a metal halide<sup>5</sup> and wherein the negative electrode can be sodium, calcium or zinc (col. 1, lines 15-22)," "Hambitzer ['631] ... discloses electrodes (those not containing LiCoO<sub>2</sub>) which are free of hydroxide ions." Here, despite claim 19 being rejected over the combination Hambitzer '061 in view of Gavelin, in the Advisory Action, the Examiner responds to arguments regarding claim

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<sup>5</sup> Although not cited, the Examiner's support for the assertion regarding the positive electrode appears to be Hambitzer '631 at col. 1, lines 45-52.

19 by citing to Hambitzer '631. Thus, it appears that the Examiner is uncertain as to what the rejection is.

The Examiner's assertion appears to be based on the disclosure in Applicants' specification that:

The inventors have found, that the passivation may be attributed to a reaction of the surface molecules of the electrode with water (e.g., from ambient humidity) resulting in the formation of a cover layer which contains a hydroxide of the active metal, i.e., in the case of an alkali metal A, a compound of the type AOH. Even small traces of water result in the formation of a hydroxide cover layer. According to the knowledge of the present inventors, the formation of a cover layer may hardly be avoided during manufacturing of electrodes whose active mass is based on a metal-oxide intercalation compound, in particular LiCoO<sub>2</sub>.

Applicants' Specification at p. 11, lines 1-9. However, the conclusion that electrodes whose active mass is not based on LiCoO<sub>2</sub> are inherently (*i.e.*, necessarily) essentially free of hydroxide ions cannot be drawn from the disclosure that reducing hydroxide ions is particularly relevant to LiCoO<sub>2</sub>.

To the contrary, as explained in detail by Dr. Ripp, nothing listed by the Examiner from the disclosure of Hambitzer '631 can reasonably be relied upon as disclosing an electrode that "is an insertion electrode that contains active metal in its interior in such a manner that the active metal is ready for ion exchange with the electrolyte during charging or discharging of the cell and has an electrode surface which is essentially free of hydroxide ions," as recited in claim 19. See Ripp Decl. at ¶¶ 26-31. Regarding sodium, calcium and zinc, "Hambitzer '631 suggests these elements as active metals forming the positive ion of the conductive salt and not as forming an insertion electrode containing active metal." *Id.* at ¶ 28. Metal halides are "electrode

materials [and] are not insertion electrodes, and ... one of ordinary skill in the art would not understand them to correspond to the feature recited in claim 19.” *Id.* at ¶¶ 29 and 30 Further carbon, “as a catalyst at the positive electrode, is not able to take up lithium ions,” “is not an insertion electrode, ... one of ordinary skill in the art would not understand the carbon to correspond to the feature recited in claim 19.” *Id.* at ¶ 31.

For each of these reasons, the rejection of claim 19 is improper, and Applicants respectfully request reconsideration and withdrawal.

Claims 38-46 depend on independent claim 19 and are patentable over Hambitzer ‘061 in view of Gavelin for the same reasons discussed in regard to claim 19.

Claims 47 and 48 depend on independent claim 1. Although the Examiner alleges that Hambitzer ‘061 discloses the subject matter of claims 47 and 48, the **Examiner failed to address how Hambitzer ‘061 and Gavelin, alone or in combination, teach or suggest the features of claim 1.** Instead, the Office Action only addresses claim 1 in the rejection of claim 1 as anticipated by Hambitzer ‘631. The rejections of claims 47 and 48 are improper at least because Hambitzer ‘061 and Gavelin, alone or in combination, fail to teach or suggest each and every feature recited in claim 1. For example, neither Hambitzer ‘061 nor Gavelin teaches nor suggests “an intermediate space between the positive electrode and the negative electrode is arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface,” as recited in claim 1. In addition, neither Hambitzer ‘061 nor Gavelin teaches nor suggests “a porous insulator ... arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the

charging of the cell through the pores of the insulator layer up to the surface of the positive electrode,” as recited in claim 1. Accordingly, the rejections of claims 47 and 48 are improper, and Applicants respectfully request reconsideration and withdrawal.

**New Claims 50-65**

**Dependent Claim 50**

Claim 50 depends on independent claim 1 and is patentable over Hambitzer ‘631 for the same reasons discussed above with regard to claim 1 as well as for the additional limitations it recites.

For example, claim 50 recites that “no barrier layer impermeable to the active mass is located between the negative electrode and the positive electrode.” Hambitzer ‘631 does not disclose or suggest this feature. In contrast, Hambitzer ‘631 only discloses battery cells having a barrier layer impermeable to the active mass located between the negative electrode and the positive electrode. *See* Hambitzer ‘631 at col. 4, lines 51-55; col. 7, lines 1-2 and 24-26; and col. 8, lines 49-51. *See also* Ripp Decl. at ¶¶ 5-14. Hambitzer ‘631 discloses embodiments in which a separator impermeable to the active mass is formed as part of the negative electrode by applying aluminum oxide to the nickel foam of the negative electrode. *See* Hambitzer ‘631 at col. 6, line 62-col. 7, line 2 and col. 7, lines 23-26. Hambitzer ‘631 also discloses embodiments in which “precision-expanded nickel foil” and a conventional separator impermeable to the active mass is used. *See Id.* at col. 8, lines 5-6. *See also* Ripp Decl. at ¶ 11. Further, one of ordinary skill in the art would understand the statement in Hambitzer ‘631 that “[a] separator layer can be applied directly this foamlike substrate” to mean that either a separator layer applied

directly to a metallic foamlike substrate of the negative electrode could be used or a separator layer that is not applied directly to a metallic foamlike substrate of the negative electrode (*i.e.*, a conventional separator layer) could be used. *See* Hambitzer '631 at col. 6, line 62-col. 7, line 2. *See also* Ripp Decl. at ¶ 12.

#### Independent Claim 51

Applicants respectfully submit that claim 51 is patentable over the cited references because the cited references, alone or in combination, fail to disclose or suggest each and every feature of claim 51. For example, the cited references fail to disclose or suggest a "battery cell ... configured such that active metal deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that short-circuit reactions occur at its surface," and a "porous insulator layer ... configured such that it is possible for active metal deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer to the surface of the positive electrode, and that any short circuits occurring as a result of the contact of active metal with the positive electrode are locally limited," as recited in claim 51.

#### Dependent Claims 52-65

Claims 52-65 depend on independent claim 51 and are patentable over the cited references for the same reasons discussed above with regard to claim 51 as well as for the additional limitations they recite.

For example, claim 52 recites that "no barrier layer impermeable to the active mass is located between the negative electrode and the positive electrode." For the reasons explained above in regard to claim 50, Hambitzer '631 does not disclose or suggest this feature.

***Conclusion***

All of the stated grounds of rejection have been properly traversed or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections, and that they be withdrawn. Applicants submit that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance.

The Applicants respectfully petitioned for a two-month extension of time. Any fees for the extension together with any additional fees may be charged to Counsel's Deposit Account No. 02-2135.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the Applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

Respectfully submitted,

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